Growing Income Inequalities in Advanced

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Growing Income Inequalities in Advanced Countries*

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Abstract

In this paper, we survey the literature that studies the issue of growing inequalities in advanced countries (the North). We firstly unveil the main facts concerning widening inequality in the North and we underlie the differences between countries and groups of countries. We put forward the concomitance of the rise in inequality with three key developments that are the three major explanations given to growing inequality: globalization, skill biased technological progress and institutional changes. We finally expose the mechanisms behind each explanation and examine the results of the empirical works that attempt to appraise their respective impacts. The overall diagnosis is that the three explanations are valid but (i) their weight may substantially differ across countries and sectors, and (ii) they interact in the determination of inequality.

Keywords: Income Inequality, Globalization, Skill Based Technological Change, Labour Market Institutions,

JEL Classification: E24, E25, F1, J2, O3

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1. Introduction

Since the early eighties, advanced countries have experienced an increase in wage inequalities between skilled and unskilled workers. The economic literature has proposed several explanations for this increase. This can be implemented from a Demand-Supply-Institution framework (Katz & Autor, 1999; Acemoglu, 1998, 2005). Considering the markets for skilled and unskilled labour, any factor that modifies the demands for and supplies of skilled and unskilled workers indeed affects the skill premium (ratio of the wage of skilled on the wage of unskilled workers), and thus the inequality between skilled and unskilled workers. Supply-side factors such as education, training, skill obsolescence, migration and demand-side factors have been analysed and estimated in an abundant literature.

In advanced countries, the increase in wage inequality between skilled and unskilled workers has coincided with:

(i) a growing unemployment gap between skilled and unskilled workers, and

(ii) an increase in the relative supply of skilled labour (except in the US where its progression slowed down in the 1990s).

The concomitance of these three developments reveals that the demand for skilled labour has grown critically faster than the demand for unskilled labour. The economic literature has thus focused on changes affecting the demand side. Three main explanations have been put forward. The first is based on technological change which is considered as skill-biased, i.e., as augmenting the demand for skilled in relation to the demand for less skilled workers. The second is the development of North-South trade (NST) analysed within a Heckscher-Ohlin-Samuelson (HOS) framework, with the 'South' (less developed countries) being characterised by a high proportion of unskilled labour with low wages, which leads to a reduction of the unskilled workers' wages in the North. The third centres on institutional changes on the labour market. In fact, institutions impact (i) on the demand for and the supply of skilled and unskilled labour and (ii) on the adjustment between supply and demand.

A large amount of literature has been devoted to estimating the impacts of technology, trade and institutions upon growing wage inequalities. The early empirical estimates typically result in the following diagnosis: (i) a significant influence from technological change, (ii) a non negligible impact of institutions in certain countries (the US and the UK), and (iii) a small impact from North-South trade. However, these early estimates contained several shortcomings: (i) the empirical methods were controversial; (ii) technological change was

exogenous; (iii) technological differences between the North and the South and international outsourcing were overlooked; (iv) technical change, NST and labour market institutions were considered as independent from each other, and (v) certain stylised facts such as labour market polarization remained unexplained. Finally, since the mid 1990s, a series of new estimates have questioned the early diagnosis.

Consequently, a new wave of empirical and theoretical approaches (i) have modelled and estimated the operating mechanisms of skill biased technological change, North-South trade and institutional changes, and (ii) have considered possible interactions between labour supply and technological change, institutions and technological change and trade and technology.

This chapter presents a review of both theoretical and empirical literature on explaining growing inequalities in advanced countries. Section 2 explores a number of stylised facts. Section 3 depicts the Demand-Supply-Institution analytical framework, and Section 4 examines the three main explanations based on technological bias and North-South trade (demand sided explanations), and on the changes in labour market institutions. Finally, Section 5 exposes the alternative mechanisms developed in the new theoretical and empirical literature. We conclude in Section 6.

2. Stylised Facts

Since the early 1980s, most OECD countries have witnessed a number of noticeable trends:

1. An increase in income and wage inequality, particularly between high-skilled and low-skilled labour;
2. A step-up in international economic integration characterised by a growing weight from developing countries in both production and trade of manufactured goods, and a transfer to the South of low-skilled intensive stages of production (international outsourcing or offshoring);
3. Major technological change, especially in the spread of information and communication technologies (ICT) throughout all industries;
4. A strengthening in labour market flexibility with a material deterioration in (i) union density, (ii) the level of the minimum wage in relation to median wage and (iii) employment protection;
5. A continuous increase in the educational level of the working population.

2.1. Growing wage inequality

The figure 1 shows that since the early eighties, most of the advanced countries have experienced a widening of wage inequalities measured by the percentile ratio P90/P10. However, the intensity of this increase critically differs across countries. The most severe increase in inequality can be observed in the US and the UK. Nordic countries (Denmark[1], Finland, Norway and Sweden) and the Netherlands have witnessed a rather moderate increase and inequality still remains low in these economies. Western Continental Europe (Belgium, France, Germany) and Japan have experienced either a low increase, or a stagnation in inequality during the last thirty years, and their inequality lies between the Scandinavian and the Anglo-Saxon (and Southern Europe) levels. A non negligible increase in inequality can however be observed in Germany dating back to the late 1990s.

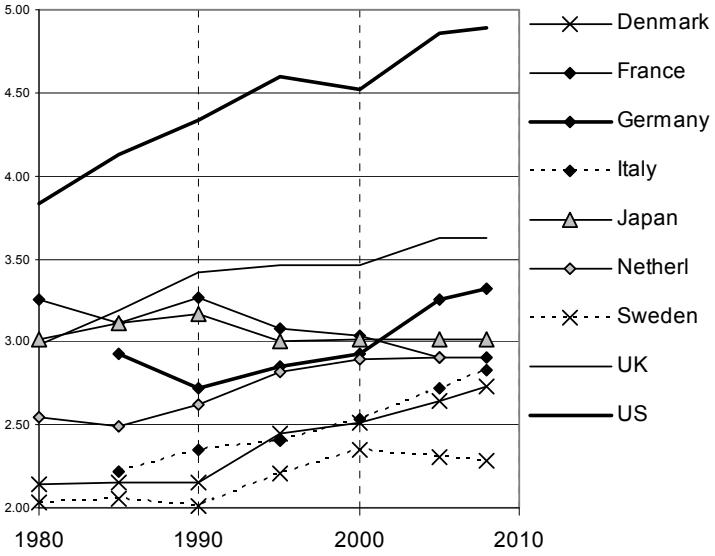


Figure 1: Ratio P90/P10 [2] in 11 advanced countries, 1979-2008 (Source OECD)

2.2. Growing income inequality

Figure 2 shows that the income inequality before taxes and transfers has increased between the mid-1980s and late 2000 in almost all OECD countries, except for the Netherlands. This increase is particularly high for France, Germany, Italy, Japan and the US. The comparison with the evolution of income inequality after taxes and transfers (Figure 3) transforms (i) the level of income inequality which suggests that redistributive policies are effective in advanced countries and (ii) the hierarchy between the countries. The least egalitarian countries are the US, the UK and Italy whereas, after taxes, the Scandinavian countries and Belgium remain

[1] Denmark has suffered a noticeable acceleration in inequality in the 2000s.
[2] Ratio of the lower limit of the 10% highest incomes on the higher limit of the 10% lowest**.**

the most egalitarian. Somewhat remarkably, whereas income inequality before taxes has decreased in the Netherlands, it has increased after taxes.

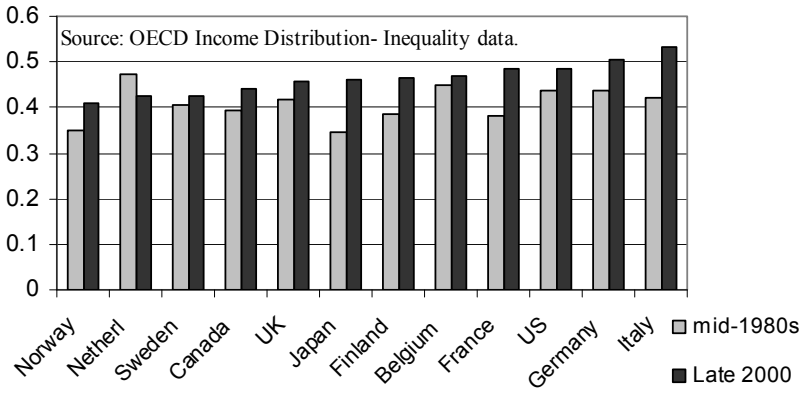


Figure 2: Gini (before taxes and transfers incomes), 12 advanced countries

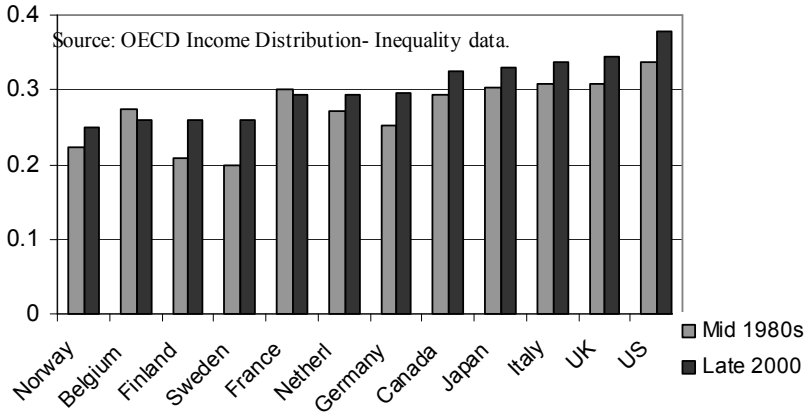
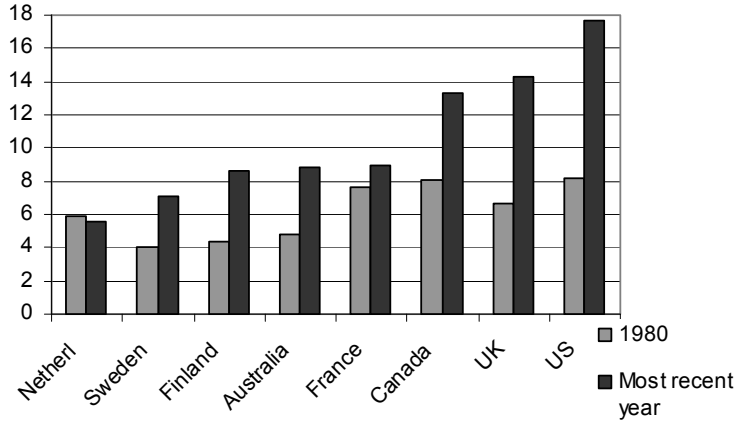


Figure 3: Gini (after taxes and transfers incomes), 12 advanced countries

Finally, the recently developed World Top Incomes database reveals a substantial rise of the income share at the top of the income distribution, especially in Anglo-Saxon countries but also in some Scandinavian countries as shown in Figure 4.

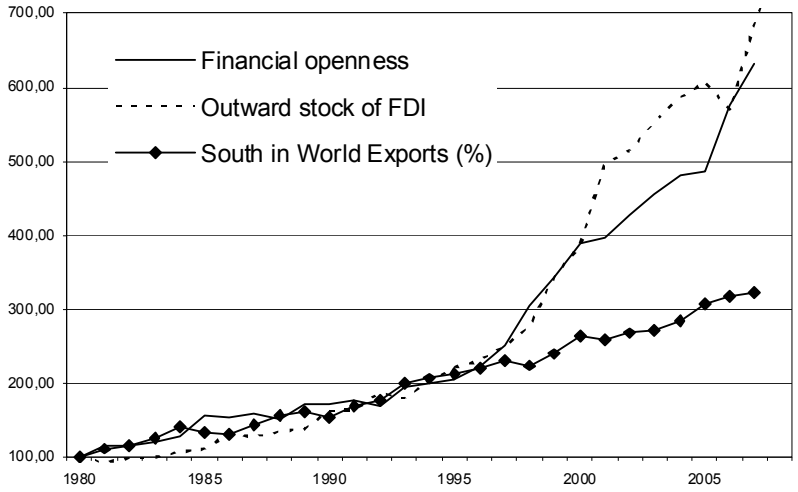


Source: The World Top Incomes Database. The most recent year ranges from 2004 to 2008.

Figure 4: Share of top 1% incomes in total income, 8 advanced countries

2.3. Globalization and North-South trade

Figure 5 shows the evolution of 3 indicators of globalization: (i) financial openness defined as the sum of cross-border liabilities and assets as a percentage of GDP for OECD countries, (ii) the outward stocks of FDI (in percent of GDP, OECD countries) and (iii) the share of the South[3] in World manufacturing exports. These three indicators have dramatically increased since the early 1980s.

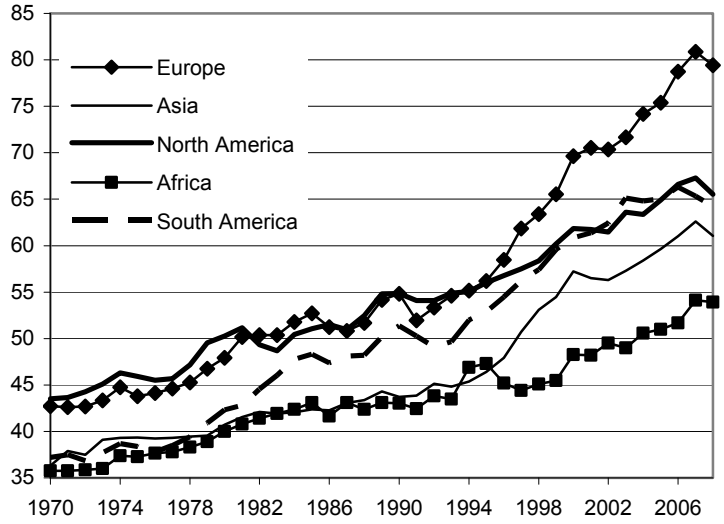


Source: OECD (2011) for Financial Openness and FDI; CHELEM database for the South in world exports (%).

Figure 5: Indicators of globalization (1980=100)

Dreher (2006 a,b) has proposed a synthetic globalization index (KOF) that combines the economic, social and political dimensions of globalization. The index of economic globalization is a weighted sum of variables reflecting actual flows and restrictions. International trade, FDI, portfolio investment and income payments to foreign nationals are considered for the globalization indicator of actual flows. Figure 6 depicts the variation in the economic index since 1970.

[3] The South comprises Mexico, Brazil, Indonesia, Northern Africa, Southern America, India, Pakistan, Bangladesh, Sri Lanka, China, Malaysia, Philippines, Thailand, South-Korea, Hong Kong, Singapore, Taiwan, Cambodia, Laos, and Vietnam.



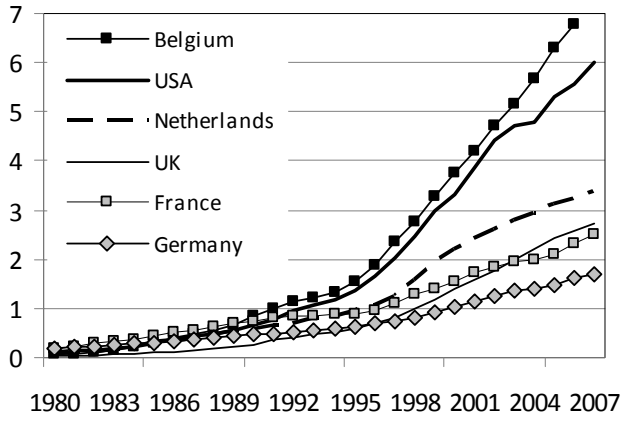
Source: http://globalization.kof.ethz.ch/aggregation/. The indicator is the weighted sum of international trade (22%); Foreign Direct Investment stocks (29%); Portfolio Investment (22%) and Income Payments to Foreign Nationals (27%), as a percentage of GDP (see Dreher, 2006, and Dreher &Gaston., 2008).

Figure 6: KOF economic globalization Index by continent (1970-2008)

All these indicators clearly demonstrate the existence of a globalization process which has significantly gathered space since the early 1990s.

2.4. A major technological change

Figure 7 depicts ICT (information & communication technologies) capital services per hour worked in manufacturing industries for a selection of OECD countries over the period 1980-2007. The use of ICT clearly took off in the early 1990s. There are substantial differences between countries, with a surge in Belgium and the USA and more moderate although still considerable increases in the UK, France and Germany.



Source: EU KLEMS (http://www.euklems.net/).

Figure 7: ICT capital services per hour worked in manufacturing, 6 advanced countries

2.5. Changes in labour market institutions: more flexibility

Since the 1980s, labour markets have become more flexible in advanced countries. These countries are characterised by:

1. A decrease in the level of the minimum wage in relation to median wage (Table 1)

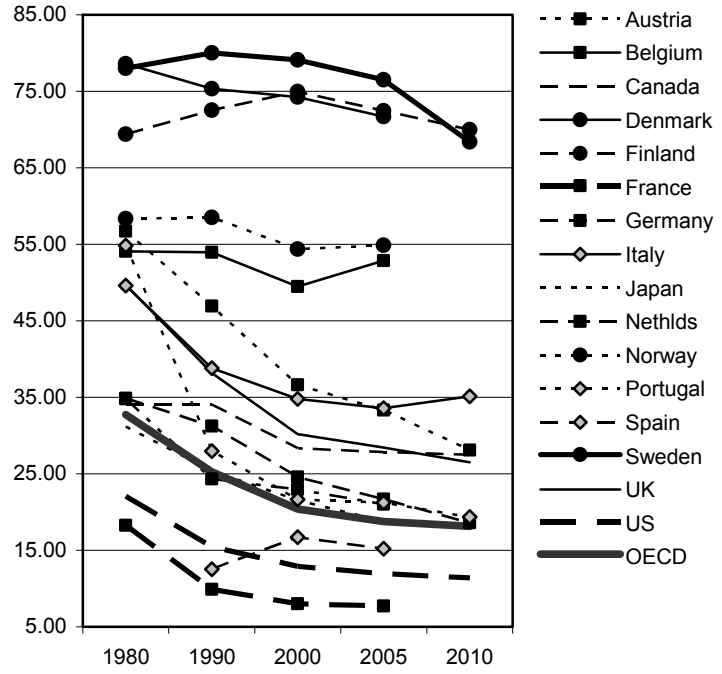
2. A decline in trade union membership, measured by the union rates (percentage of union members in the working population), as depicted in Figure 8.

3. A relaxation of the legislation on employment protection (Figure 9).

Table 1 Ratio minimum wage/median wage in advanced countries, 1975-2008.

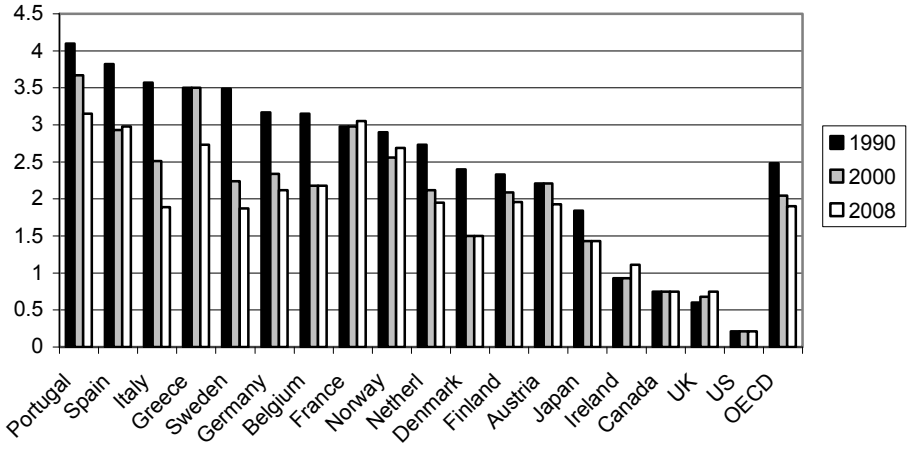
	1975	1985	1995	2005	2008
Australia	..	0.652	0.62	0.575	0.522
Belgium	0.548	0.567	0.562	0.509	0.508
Canada	0.513	0.389	0.425	0.4	0.414
France	0.439	0.517	0.524	0.597	0.603
Ireland	..	..	..	0.54	0.524
Japan	0.276	0.311	0.306	0.335	0.346
Netherlands	0.666	0.615	0.525	0.479	0.47
New Zealand	0.647	0.447	0.498	0.544	0.591
Portugal	0.7	0.594	0.518	0.525	0.524
Spain	0.647	0.509	0.439	0.442	0.442
UK	..	..	..	0.45	0.461
US	0.454	0.384	0.355	0.316	0.341

Source: OECD Statistics, stats.oecd.org



Source: OECD Statistics, stats.oecd.org

Figure 8: Union rates in advanced countries, 1980-2010

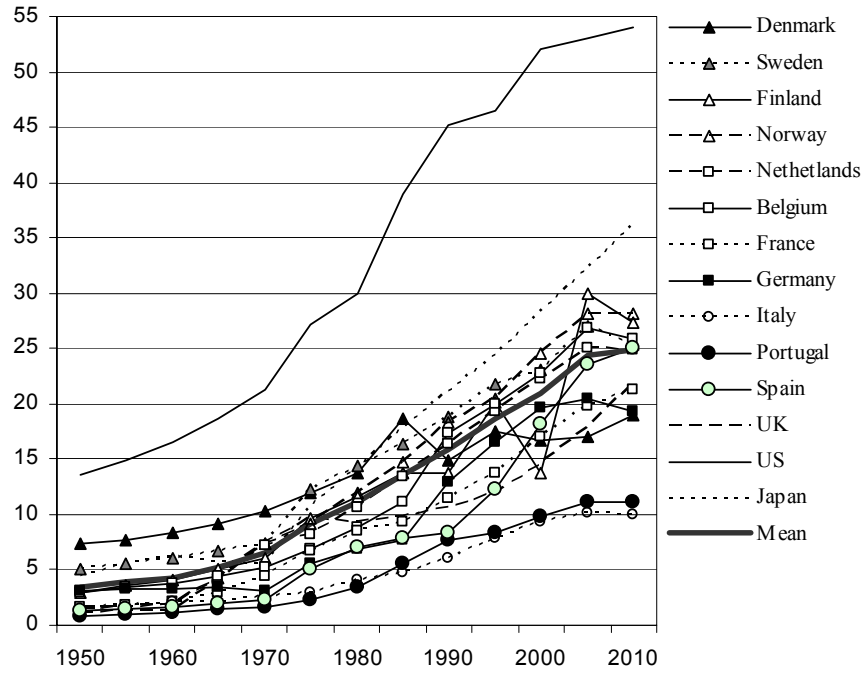


Source: OECD Statistics, stats.oecd.org

Figure 9: Change in employment protection in advanced countries, 1980-2010

2.6. Changes in the labour supply: a general skill upgrading

As shown in Figure 10, the percentage of the population with a tertiary education degree has critically increased in all OECD countries. However, the levels as well as the evolution differ across countries.



Source: Barro and Lee (2010), http://www.barrolee.com

Figure 10: Percentage of the population over 25 with tertiary education (1970-2010)

3. The Demand-Supply-Institution framework

A supply-demand-institution framework (Freeman and Katz, 1994; Katz and Autor, 1999; Acemoglu, 1998, 2005) is used to explain increasing wage and unemployment inequalities between skilled and unskilled workers. This approach considers a heterogeneous labour market with two types of labour: skilled and unskilled labour within a neoclassical framework. An increasing wage inequality between the skilled and the unskilled (i.e. a higher skill premium) may emanate from several factors modifying the relative demand or supply of skilled labour. For instance, a rise in the relative demand for skilled workers higher than an increase in the relative supply for skilled labour leads to an increase in the skill premium and thus in wage inequality. Moreover, for a given supply, labour market institutions that prevent the skill premium adjustment (e.g. minimum wage, collective bargaining, unemployment benefits, etc) bring about the unemployment of unskilled workers (Davis, 1998a; Acemoglu, 2005).

The stylized facts discussed in Section 2 show a general tendency of rising income inequality in OECD countries over the last three decades. They also reveal considerable differences across countries. The framework proposed by Acemoglu (2003a) provides a good starting point to explain the general trend, as well as cross-country heterogeneity, due to shifts in the supply of and demand for high-skilled workers (in relation to low-skilled workers) and country-specific labour market institutions.

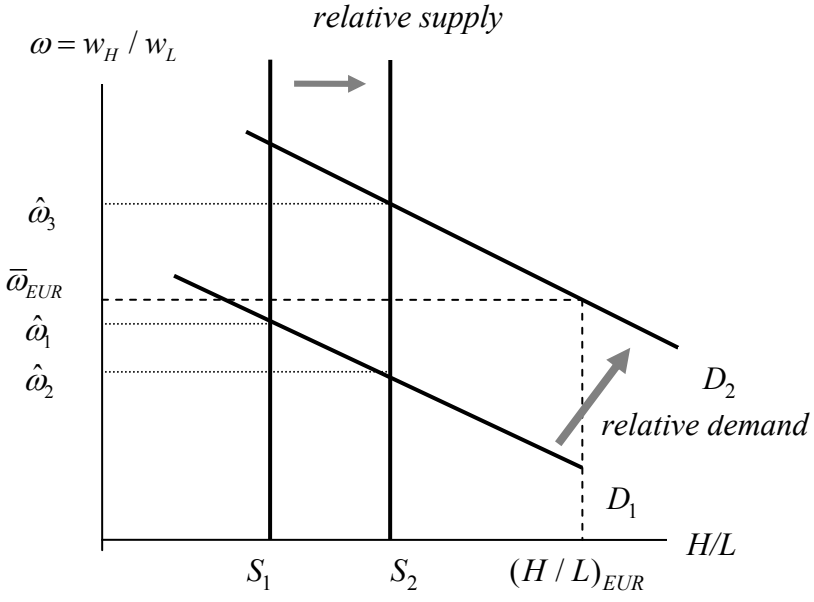


Figure 11: The Supply-Demand-Institutions approach (adapted from Acemoglu, 2003a)

In Figure 11, the skill intensity and the skill relative supply (i.e. the ratios *H/L* of the number of high-skilled workers *H* on the number of low-skilled workers *L* respectively in production and in countries) are mapped on the *x*-axis and the skill premium $\omega = w_H / w_L$ (relative wage of high-skilled workers) on the *y*-axis.

The vertical relative supply lines reflect the assumption that supply does not respond to short term changes in the skill premium because it takes time to obtain a tertiary degree. Let us suppose that, at any time, both Europe and the US demonstrate the same relative supply and demand for *H/L*, and thus the same skill premium equilibrium. If S_1 and D_1 are respectively the supply and demand for *H/L* at the initial time, then both countries share the same equilibrium skill premium $\hat{\omega}_1$. Let us firstly suppose an increase in the relative supply of skill that shifts from S_1 to S_2. This corresponds to the skill upgrading observed in both the US and Europe in the sixties and seventies. This typically diminishes the skill premium from $\hat{\omega}_1$ to $\hat{\omega}_2$, i.e., less inequality. Suppose now an increase in demand that shifts from D_1 up to D_2 due to skill biased technological change and/or North-South openness. Then, the equilibrium skill premium moves up to $\hat{\omega}_3$. If labour markets are competitive in the US, this induces full employment with a large increase in the skill premium and inequality, that shifts from $\hat{\omega}_2$ to $\hat{\omega}_3$. Assume that in contrast there is wage rigidity in Europe because of a minimum wage or union bargaining power, which prevents the skill premium to move above $\overline{\omega}_{EUR}$. Then, the ratio of factor utilisation is $(H / L)_{EUR}$ in Europe. This brings about a moderate rise in inequality in Europe ($\overline{\omega}_{EUR}$ is not that far from $\hat{\omega}_2$) and the unemployment of unskilled workers because $(H / L)_{EUR} > S_2$.

Cline (1997) explains the drop in the US skill premium in the 1970s by the surge in the relative supply of high-skilled workers that had dominated any relative labour demand effect. In the 1980s the relative supply continued to increase but less spectacularly, insofar as the supply effect was dominated by an increased demand for high-skilled workers, resulting in a rising skill premium. Card & Lemieux (2001) attributed the rise in the skill premium in Canada, the UK and the US to the slowdown in the growth rates in educational attainment, a slowdown which apparently already started in the 1950s. Goldin & Katz (2008, 2009) explained the decrease in the US skill premium in the first half of the 20th century by rising educational attainment in that period. For people born after 1950, there was a deceleration in college graduation. When the relative demand for high-skilled workers started to increase, the skill premium rocketed in the 1980s.

4. The three explanations and their empirical relevance

In all OECD countries, the educational level of the working population has ascended since the seventies. Since the skill premium has also risen, the demand for skill should have increased much more than the supply. The literature has focused on two main explanations of an increase in the relative demand for skilled workers: (i) globalization characterised by a development of North-South trade, and (ii) a skill-biased technological change (SBTC). Finally the rise in inequality can also originate from changes in institutions on the labour market and from a weakening of the Welfare State.

4.1. North-South trade and globalization

The HOS approach and the early estimates

The impact of North-South trade (NST) upon wage inequality between skilled and unskilled workers has been analysed within a Heckscher-Ohlin-Samuelson (HOS) approach. Let us consider a ' $2 \times 2 \times 2$ ' HOS model with two factors of production, unskilled labour and skilled labour, used to produce two goods (one unskilled labour intensive and the other skill intensive) in two areas, the North (advanced countries) and the South (emerging countries). The North is assumed highly endowed with skilled labour and the South with unskilled labour. The North (South) thus displays a comparative advantage for the skill intensive good (good intensive in unskilled labour). From these assumptions, North-South trade openness leads to the following outcomes in the North: (i) a decrease in the relative price of the good intensive in unskilled labour and thus a rise in the skill premium (Stolper-Samuelson theorem); (ii) a decrease in skill intensity in all industries, and (iii) a rise in the weight of skill intensive industries in total production.

Several additional outcomes must be underlined. First, if wage adjustment is prevented by labour market institutions, NST produces unemployment of unskilled workers in the North, and this unemployment is concentrated within the countries where the skill premium adjustment is being impeded (Davis, 1998a and b). Secondly, these predictions are obtained within a HOS framework assuming (i) the same technology in the North and in the South, (ii) trade and production of final goods only (no intermediate goods), and (iii) that the different stages of production of one good are all located within the same country. These 3 assumptions are clearly not in line with what it is observed and overlook both technology divergence (and technology catch-up) and international outsourcing.

The impact of North-South trade has been estimated using several methods: factor content method, decomposition analyses and comparison of HOS predictions with stylised facts.

Factor content method (FCM) consists in calculating the amount of skilled and unskilled labour (i) used in producing the North's exports to the South, and (ii) which would be used to substitute domestic production for imports from the South. The difference between the two measures the net creation or destruction of employment in the North due to trade with the South.

Decomposition analysis consists in decomposing the change in the weight of skilled labour in total employment between within-industry and between-industry changes. The within-industry part of the decomposition was considered as essentially resulting from SBTC. The between-industry part was considered as essentially determined by NST because NST acted through relative prices (Stolper-Samuelson Theorem). In the 90's, the impact was econometrically tested using this method. Considering the within-industry effect, Berman, Bound and Griliches (1994) estimate the impact of a set of variables (such as the relative price of skilled labour in the relevant industry, the capital intensity of production and other variables controlling for industry) on a change in the weight of skilled labour in total employment for one particular industry. Technological change is then assimilated to the constant and residual terms of the estimated equation.

Finally, if the HOS approach correctly portrays North-South trade, and if it has a major impact on the specialisation of the North, all the HOS predictions must be verified.

The early estimates carried out in the early 1990s conclude that the influence of North-South trade is minor.

Using FCM, most of early analyses show a minor impact of NST upon factor demand and growing wage inequality: only 5-15% of the decrease in the employment of the unskilled is attributed to NST (Katz & Murphy, 1992; Borjas et al.1994; Sachs & Shatz, 1994).

Decomposition analyses revealed that within-industry changes were clearly dominant, which was interpreted as the prevalence of skill biased technological change over North-South trade (Bound & Johnson, 1992; Berman, Bound & Griliches, 1994).

Finally, the HOS approach cannot be the main explanation for the observed developments because (i) almost all sectors have become more skill-intensive (Krugman & Lawrence, 1993), (ii) prices had not grown faster in skilled labour intensive industries than in unskilled intensive ones (Lawrence and Slaughter, 1993), and (iii) because there is no tendency towards North-South wage equalisation. For Krugman (1994, 1995), this weak impact of North-South

trade was because trade with the South accounted for a very low percentage of the North's GDP, and thereby played an insignificant role in the shift in factor demand.

However, the methods used have been questioned.

Firstly, mention can be made of several limitations to the factor content method. The substitution in value under-estimates the reduction in factor demand induced by imports from the South. It is better to use substitution in physical unit, but it is thus necessary to consider (i) the price divergence between the North and the South, (ii) the price elasticity of demand, and (iii) the resulting reduction in the demands for goods. It is also necessary to take into account the differences in technology and in factor prices between the North and the South which means using factor coefficients of the South for goods not produced in the North and estimating the elasticity of substitution. Using the factor content method, but correcting several of its most controversial aspects, Wood (1994) obtains a serious downturn in unskilled and total employment induced by North-South trade (-21.5%). In addition, Leamer (1994) considers factor content method as 'calculation without theory'. Finally, by comparing North-South openness to North in autarky, this method neglects the North-North market losses for northern countries previously specialised in unskilled labour intensive goods.

Secondly, decomposition analyses considered the within-industry changes as reflecting SBTC and the between-industry changes as essentially driven by North-South trade. However, between-industry changes can represent a sector skill biased technological change: a sector SBTC entails a higher total factor productivity growth in skill intensive sectors, and thus modifies the sector structure of production in favour of the latter.

Thirdly, decomposition analyses overlook international outsourcing whereas this modifies the within-industry factor utilisation and produces the same apparent result as a factor skill biased technological change. The within-industry effect can no longer be considered as representing SBTC alone.

International outsourcing or offshoring

International outsourcing or offshoring refers to situations where one or several of the segments of production are located abroad. Outsourcing is thus defined as "*the imports of intermediate inputs by domestic firms*" (Feenstra and Hanson, 1996b, p.240), which means that these intermediate goods can be bought from both foreign firms and foreign subsidiaries of domestic firms.

Offshoring is disregarded in the HOS model, whereas it may significantly modify its predictions. Feenstra & Hanson (1996a) develop a North-South model with a single manufactured good produced from a continuum of intermediate goods that differ in their skill intensity. The weight of the South grows in that it produces an increasing share of the range of inputs. The inputs outsourced to the South are increasingly skill intensive, which leads to the following results: (i) the share of the South in total labour payments increases, (ii) the relative demand for skilled labour and the skill premium rise in the North and in the South, and (iii) international outsourcing lowers the price of the final good. Finally, if the increase in outsourcing to the South is sufficiently small, the price effect outweighs the negative wage effect leading to an overall welfare gain for both types of labour in both regions.

However, offshoring to low-skill abundant countries may favour low-skilled workers in high-skill abundant countries (Arndt, 1997; Venables, 1999; Jones & Kierzkowski, 2001). Gao (2002) presents a two country model where outsourcing and the relative wage of skilled labour are endogenously determined and shows that globalization, in terms of reduction in trade costs, leads to a rise in both outsourcing and skill premium in both the countries. Glazer & Ranjan (2003) provide another useful explanation. In a two-country framework, if skilled people consume relatively skilled intensive goods compared to the unskilled people, an increase in supply of skilled labour in either country might cause an increase in demand for skilled labour and widen the wage gap in both countries.

An abundant literature has measured the impact of outsourcing upon wage and unemployment inequality. In almost all estimations, one finds a statistically significant negative influence of outsourcing to the South on the labour market position of low-skilled workers (Anderton & Brenton, 1999b; Feenstra & Hanson, 1996b, 2001; Anderton, Brenton & Oscarsson, 2002; Egger & Egger, 2003; Strauss-Kahn, 2003; Dumont 2006).

In a recent survey of empirical work on the labour market effects of offshoring, Crinò (2009) has concluded that most studies suggest that the impact of material offshoring (relocation of production activities) during the 1980s and 1990s on wage inequality has been of a similar magnitude as the impact of SBTC and may also have resulted in (i) higher employment volatility and (ii) an increase in labour demand elasticity. To date, the relocation of service jobs so far does not seem to have borne a considerable impact on employment but some studies indicate that service offshoring shifts relative labour demand in favour of high-skilled workers. Studies that considered the relocation of activities to foreign affiliates within MNEs produce smaller estimated effects than studies that consider a broader definition of offshoring. Scholars who have considered more than two skill levels found indications of a negative

impact of material offshoring on the demand for low- and medium-skilled workers. In a recent article, Antonietti & Antonioli (2011) used a matching procedure (difference-in-difference) to estimate the effects of offshoring by Italian manufacturing firms in the period 1995-2003. Offshoring resulted in a decline in employment of production workers, which indicates that it tends to substitute for low-skilled workers. What they found is in line with previous results (Strauss-Kahn, 2003; Hijzen et al. 2005). For Germany, Becker et al. (2009) revealed that offshoring shifted demand in favour of high-skilled workers and appears to explain only up to 15% of changes in wage bill shares over the period 1998-2006.

Recent estimates of the impact of globalization

Chusseau et al. (2008), Crinò (2009) and Harrison, McLaren & McMillan (2010) pointed out that more recent empirical findings attribute a substantial role to international trade.

Following up on earlier work (e.g. Lawrence & Slaughter 1993) on *the link between import prices and factor prices*, Edwards & Lawrence (2010) put forward certain developments that contradict the Stolper-Samuelson theorem and thus the HOS model's predictions. The increase in US import prices weighted by the employment share of low-skilled workers (production workers) in relation to the import prices weighted by the employment share of high-skilled workers (non-production workers) observed between 1987 and 2006, should have exerted downward pressure upon wage inequality. They also found that US industries with a high share of imports of manufactured goods from low-wage countries were more skill intensive than industries with a high share of imports from high-wage countries. They apply a two-stage mandated wage regression on a panel of 4-digit US industries over the period 1993-2006, and distinguish imports from developed countries, China, Mexico, Asian countries and a group of other developing countries. The estimates suggest that imports from China increased the wages of production as well as the wages of non-production workers, and although they also increased the skill premium, the latter effect was not statistically significant. From their analysis, Edwards and Lawrence conclude that the Stolper-Samuelson theorem is rather irrelevant as high-wage and low-wage countries are apparently fully specialised in producing different goods. They argue that, as a consequence, factor content studies or studies that assume a close link between imported and domestic goods may provide misleading conclusions.

However, Kurokawa (2011) recently showed that when variety and high-skilled labour are complementary, and when international trade increases the variety of intermediate inputs used in the production of final goods, imports may intensify wage inequality in all countries (high and low-wage countries). This result is obtained without high import volumes or an increase

in the relative price of skill intensive goods. This rather straightforward model explains some of the circumstantial evidence that was considered to refute the HOS model in early empirical studies.

Krugman (2008) revised his earlier argument concerning the limited role of international trade in explaining rising US wage inequality. He points out that since the early empirical studies, *the share of developing countries in US imports has doubled*, and that those countries that accounted for the largest share in the recent increase (e.g. China and Mexico) have average wages well below the wages of major low-wage exporters (e.g. Asian tigers) in earlier decades.

Another argument is *the increased segmentation of production*. Low-wage countries may specialise in low-skill intensive activities in high-skill intensive industries. This phenomenon may be blurred by the high level of industry aggregation of available data, e.g. input-output data used in factor content analysis. This could explain some of the apparent HOS anomalies but, as Krugman argued, also hampers the reliable quantification of the impact of imports on relative wages as existing data do not reflect the sophisticated patterns of current international supply chains.

New *factor content calculations* by Feenstra (2008) show the potential magnitude of the industry aggregation bias for the period 1982-2000. From 1994 onwards the impact of imports on production workers increases dramatically when computed at the 10-digit industry level as opposed to the 4-digit level. In 2000, imported production labour, as implied by the factor content, amounted to some 2000000 workers when computed at the 4-digit level but almost 14000000 workers when computed at the 10-digit level, which was actually more than the number of production workers employed in the US manufacturing sector. Feenstra pointed to the rather substantial impact of international trade on wages imputed from calculations at a more detailed level of industry aggregation than previously carried out.

A number of recent empirical studies have adopted a more a-theoretical approach to assess the impact of globalization by considering *multiple dimensions of globalization*. In many studies, globalization is often restrictively conceptualised as the increasing international flow of goods. Dreher (2006 a,b) proposed a composite globalization index (KOF) which considers different dimensions of globalization. The index of economic globalization is a weighted index of a sub-index of actual flows and a sub-index of restrictions. Actual flows consist of international trade, FDI, portfolio investment and income payments to foreign nationals, all of which are considered relative to GDP. Restrictions are reflected by hidden import barriers, average tariff rates, taxes on international trade and capital controls. In addition, Dreher

considered an index on social globalization consisting of variables that reflect personal contact (e.g. outgoing telephone traffic and the proportion of foreigners in the population); information flows (e.g. internet hosts and users) and cultural proximity which is measured by a country's total number of McDonald's outlets per capita.

Dreher and Gaston (2008) assessed the link between the KOF globalization index and respectively an indicator on industry pay inequality and an indicator on household income inequality, both provided by University of Texas Inequality Project. Regressions on a panel of 123 countries indicated that globalization widened industry pay as well as household income inequality although the effects appeared only to be statistically significant for OECD countries.

Dreher & Gaston (2007) found that the social dimension of globalisation (KOF index) may explain the decline in union membership for a panel of 17 OECD countries over the period 1980-1999 whereas economic globalization was not found to have produced any significant impact.

Bergh & Nilsson (2010) estimated for a panel of 79 countries the link between the KOF globalisation index as well as the Economic Freedom Index (developed by the Fraser Institute) and Gini coefficients of income inequality from the World Income Inequality Database between 1970 and 2005. They found a positive correlation between freedom to trade internationally and within-country income inequality, and a positive correlation with inequality of deregulation (dimension of freedom index) and social globalization (dimension of KOF index). Economic freedom mainly increased inequality in rich countries whereas social globalization bears a significant impact upon inequality in middle-and low-income countries.

Other empirical studies have estimated the impact of globalization upon income or wage inequality. Lee (2006) regressed a Gini coefficient of income inequality on a number of potential determinants such as trade openness (Exports + Imports over GDP) and FDI (net FDI inflows over gross fixed capital formation) using data on a panel of 14 EU countries over the period 1951-1992. The results suggest that FDI increased inequality, but Lee finds no significant effects of trade openness.

Running a Mincer wage regression for the US, Kosteas (2008) shows that imports from low-wage countries had a substantial negative impact on the wages of blue-collar workers in the period 1979-1988. The impact was not significant for the period 1989-1996. The effect of technological change, proxied by TFP, was not significant.

Epifani & Gancia (2008) proposed a model in which market size is positively correlated with wage inequality. They test the model for (i) a panel of 40 countries between the early 1960s and the late 1990s (education premium), (ii) a panel of 35 countries over the period 1980-1990 (skill premium), and (iii) a panel of 68 countries between the early 1960s and the late 1990s (Gini coefficient of net income distribution). They found evidence that inequality indeed intensifies with market size. The positive impact of trade openness on inequality was even more robust.

4.2. Exogenous skill-biased technological change

Definition

The literature distinguishes two types of skill biased technological change, i.e., a factor bias and a sector bias. A pure factor bias increases the total relative demand for skill of the economy (H^d / L^d) for given prices of skilled labour *H* and unskilled labour *L*, i.e., the skill premium (w_H / w_L) remaining unchanged. With a Cobb-Douglas technology ($Y = AL^{\alpha}H^{1-\alpha}$), this consists of an increase in the ratio $(1-\alpha)/\alpha$, and an increase of $(1-a)/a$ for the CES production function $Y = A\left(aL^{\theta} + (1-a)H^{\theta}\right)^{1/\theta}$. In the case of a pure sector bias, technological change is factor neutral in the production function, but it is stronger in skill-intensive industries than in unskilled intensive ones. This takes the form of a rise in total factor productivity (TFP) which is higher in the former than in the latter[4].

Capital-skill-complementarity

Let us suppose 3 factors: *H, L*, and capital *K*. If technological progress leads to augmenting the utilisation of *K*, and if *K* is more substitutable for *L* than for *H*, then the higher use of *K* will induce higher H^d / L^d, i.e., SBTC (Griliches, 1969; Krusell et al., 2000; Falk & Koebel, 2004). With capital-skill-complementarity, a technological progress which results in augmenting the utilisation of *K* induces higher H^d / L^d, i.e. SBTC.

The first empirical estimates of SBTC

Lots of papers have explored the impact of SBTC on wage inequality. Two mains methods have been used: (i) direct estimates of the impact of several determinants, among which technical change and North-South trade indicators, on the relative demand for skilled labour

[4] It may be shown that a necessary condition for such a sector bias to produce a rise in ratio H^d / L^d is that the elasticity of substitution between *H*-intensive and *L*-intensive goods is higher than one (Krugman, 2000).

or on the skill premium, using flexible cost function (usually Translog cost function), and (ii) decomposition analyses. Within both methods, the constant and the equation residual term represent technological change.

The first set of empirical estimates bears the significant influence of technological change. Direct estimates have suggested that technological change had a significant impact on the skill premium and the demand for skill (Bartel & Lichtenberg, 1987; Allen, 1996; Doms, Dunne & Troske, 1997). Moreover, decomposition analysis has revealed that within-industry changes were clearly dominant, which has been interpreted as the prevalence of skill biased technological change over North-South trade (Bound & Johnson, 1992; Berman, Bound & Griliches, 1994).

However, the literature has shed light on the several shortcomings underlying the methods that have been applied. Firstly, technological bias is considered as naturally biased: it is exogenous and thus not explained. Secondly, technological change can be endogenous, and moreover a Hicks-neutral technological change may increase the relative demand for skill and thereby the skill premium (Moutos, 2000). Finally, there is no interaction with the other explanations. However, institutions may influence technological change (Acemoglu, 2003a), and North-South openness may influence the shape of technological change (Wood, 1994).

Recent estimates of the impact of skill-biased technological change

Whereas surveys of early empirical studies generally concluded that SBTC dominated international trade in explaining rising inequality, more recent theoretical and empirical contributions provided more ambiguous conclusions.

Antonelli & Quatraro (2010) rightly pointed out that total factor productivity estimates are biased if technological change is not neutral. They estimated TFP by accounting for a possible factor bias in technological change, for a panel of 10 OECD countries over the period 1971-2001. For Finland, Italy, Sweden, the Netherlands and the UK, innovation efforts were biased in favour of high-skilled workers, in Denmark and the US technological changes appear to have been neutral and in Belgium and France technological was even biased in favour of low-skilled workers.

DiNardo & Pischke (1997) wrote an early paper questioning the role of SBTC in explaining wage inequality. Using German data the authors pointed out that wage differences were not only highly correlated with computer use but also with telephones, pens and pencils. These results indicate a serious causality issue, i.e. high-skilled workers are likely to use computers more intensively than low-skilled workers and high correlations can therefore not be considered as evidence of ICT increasing the skill premium. Using more recent data for

Germany, Spitz-Oener (2008) re-considered the role of computers within a task-based framework. Her analysis suggests that computers -and not pencils- shifted demand in favour of analytical and interactive tasks, away from routine tasks.

For a panel of 9 EU countries, Japan and the US over the period 1980-2004, Michaels, Natraj & Van Reenen (2010) found evidence that ICT has increased relative demand for high-skilled workers and shrunk demand for medium-skilled workers, leaving low-skilled workers rather unaffected. Technological change (ICT and R&D) could explain up to 25% of the growth of the share of graduated workers in the wage bill.

Lemieux (2008) argued that the traditional view of SBTC fails to explain recent trends in US and UK wage inequality whereas changes in labour market institutions have more explanatory power.

As the rise in skill intensity in non-traded sectors is similar to the rise in skill intensity in traded sectors, Katz (2008) concluded that skill-biased technological change still appears to dominate international trade (Stolper-Samuelson effects) in driving relative labour demand. Van Reenen (2011) also argued that technology largely explains the recent labour market trends but pointed out that technology is partially induced by international trade, e.g. increased import competition from China.

In conclusion, the recent empirical approaches have shown the following results: (i) the impact of SBTC has been revisited, and its supremacy is questioned, and (ii) outsourcing is the main vector of impact from NST.

4.3. Changes in (labour market) institutions

Stylised facts presented in Section 2 have demonstrated a general tendency towards increased labour market flexibility in most OECD countries. The framework developed by Acemoglu (2003a), as discussed in Section 3, shows how labour market institutions (minimum wage, collective bargaining) could provoke the unemployment of low-skilled workers by preventing wage adjustment towards market-clearing levels. Country-specific labour market institutions may thus explain part of the heterogeneity observed in the evolution of inequality in advanced countries (Krugman, 1994; Blank, 1997, Davis 1998a). Some countries like the US would have let the market forces work, so causing growing wage inequality. In contrast, Europe would have opted for preventing the rise in inequality through institutional rules (minimum wages, wage agreements etc.), but in so doing created unemployment of the less skilled. This explanation, labelled by Atkinson (2001) as the 'Transatlantic consensus', implies a trade-off between inequality and unemployment (see Chapter 5).

Empirical impacts of labour market institutions upon unemployment

Concerning unemployment, the common diagnosis is that certain institutions have yield a sizeable influence on unemployment (e.g., the tax wedge) whereas others have had a negligible impact (e.g. minimum wage). Both Krueger & Pischke (1997) for the US, and Card et al. (1999) for the US, France and Canada found no impact of wage rigidity on the unemployment of the unskilled in relation to the unemployment of the skilled. In contrast, such a relation is found by Puhani (2008) who analyses and compares the cases of West Germany, Britain and the US. Assessing the impact of policies and institutions on employment and unemployment in OECD countries over the past decades, Bassanini & Duval (2006) find that high unemployment benefits and high tax wedges increase unemployment, whereas employment protection legislation has no significant impact and centralised and/or coordinated wage bargaining systems reduce unemployment. Jackman et al. (1997) test the so-called 'Krugman hypothesis', i.e. that rigidity in relative wages raises the unemployment of the less skilled and lowers the unemployment of skilled workers, for the US, Britain and a number of European countries since the 1970s. They find that the Krugman hypothesis cannot explain the developments in Britain and Europe.

Empirical effects of labour market institutions upon wage inequality

As regards inequality, the impact of institutions seems rather uneven across countries, the most significant influence being found in the UK (Machin, 1997) and the US (Fortin & Lemieux, 1997; Card, 2001). Koeniger et al. (2007) use panel data in 11 OECD countries between 1973 and 1998 to assess the impact of changes in institutions upon the increase in wage inequality among male workers. They find that stricter employment protection legislation, more generous benefit replacement ratios, longer benefit duration, higher union density and a higher minimum wage all reduce wage inequality. Changes in these institutions can explain many of the changes observed in male wage inequality within OECD countries. In addition, changes in institutions has reduced inequality in France whereas these have increased inequality in the US and Britain. Calderon & Chong (2009) present an empirical study of the impact of labour market regulations on income distribution (and thus inequality) by discriminating between *de jure* and *de facto* regulation rules. The first are institutionalised but not always enforced, and the second derive from the practice and behaviours of the labour market participants. They find (i) that both *de jure* and *de facto* regulations flatten the income distribution although this impact is less robust for the former than for the latter, and (ii) that the different regulations appear to have rather uneven effects on the distribution of income.

Dustmann, Ludsteck & Schönberg (2009) decomposed inequality in Germany into price and composition effects. They concluded that technological change may explain rising inequality at the top of the distribution (mainly in 1980s) whereas the rise in inequality at the bottom of the distribution can be explained by relative labour supply and changes in labour market institutions, e.g. decline in union membership and minimum wages. The empirical analysis presented in OECD (2011) suggests that changes in institutions (declining tax wedge, more flexible employment protection and product market regulation, and decreased union coverage and unemployment benefits) provided the main explanation for the rise in the D9/D1 wage differential in OECD countries over the period 1980-2008. Technological change (R&D) also increased inequality whereas the rising education level counterbalanced these factors. Trade exposure does not seem to have produced a significant effect.

4.4. Taxes

Figure 2 and Figure 3 show substantial differences in the ranking of countries when considering income inequality before or after taxes. As shown in The OECD (2011), redistribution through income taxes and social security contributions is substantial in the Nordic countries, Belgium, France and Germany but far less so in most Anglo-Saxon countries. In many OECD countries taxes appear to have become less progressive. Top rates of personal income tax have dropped dramatically in some OECD countries, from 60% up to 70% to an average of 40% by late 2000. The OECD (2011) argued that the substantial rise in the share of top-income earners in total income (see Figure 4) implies that their capacity to pay taxes increased and that therefore more progressive taxes may be an effective tool to reduce the sharp increase in inequality, especially by scaling back tax reliefs for the well-to-do (OECD 2011: p. 40).

5. Combined explanations

The economic literature has focused on new approaches aiming at theorising the operating mechanisms of SBTC, North-South trade and labour market institutions, particularly modelling their interactions. Several types of possible interactions have been put forward and analysed: (i) trade-induced technological change (e.g. Wood, 1994; Thoenig & Verdier, 2003), (ii) labour supply-induced technological change (e.g. Acemoglu, 1998, 2002), (iii) institutions-induced technological change (e.g. Acemoglu, 2003), (iv) technology-induced

offshoring (e.g. Levy & Murnane, 2006, Lemieux, 2008), and (v) labour market polarization and trade-in-tasks models (Acemoglu & Autor, 2011).

5.1. Trade-induced technological change

Facing competition from the South, firms are encouraged to promote skill-biased technological change (Wood, 1994). Thoenig & Verdier (2003) provides a theoretical justification for trade-induced technological change: when property rights on innovations are not enforced in the South, Northern firms forsake research in technologies that may be adopted by Southern firms. They thus concentrate R&D on skill-biased technological changes that LDCs' firms cannot appropriate. This motive also plays a central role in Acemoglu's analysis (1998) of the impact of North-South trade on directed technological change.

Acemoglu (2003a) develops a model with two final goods, one skill-intensive and the other unskilled-intensive, where North-South openness triggers skill-biased technological change regardless of the enforcement of property right in the South. In this model, North-South trade increases the relative price of the skill-intensive good, which encourages technical progress in this industry and thus the demand for skilled labour. In addition, skill-biased technological change subsequently causes the relative price of skill intensive goods to decrease, which is consistent with observed developments.

Bloom, Draca & VanReenen (2011) found support for trade-induced technological change. Using firm-level data for 12 EU countries, import competition from China seems to affect technological change through two channels, i.e. an increase in R&D and TFP within firms and reallocation of employment in favour of the more innovative and technologically efficient firms. The results suggest that competition from China could explain some 15% of the technological change that occurred in Europe between 2000 and 2007.

5.2. Skill supply induced technological change

Acemoglu (1998) developed a model of endogenous technical change and growth in which an increase in skill supply causes a decrease in the skill premium in the short term - because of the usual supply-demand mechanism - and a rise in the skill premium in the longer term. In the longer term, higher endowment of skilled labour directs the research activity towards skill-complementary technologies. This 'directed technology effect' now increases the demand for skilled labour, thereby raising the skill premium. In a recent paper, Acemoglu (2005) has analysed the general conditions for such a mechanism to operate. It is firstly shown that with factor-augmenting technologies, the increase in the supply of one factor

always induces technological change that is relatively biased towards that factor. Secondly, it has been demonstrated that an increase in the supply of a factor always prompts a technological change that is absolutely biased towards that factor.

5.3. Institutions-induced technological change

Acemoglu (2003b) describes a model where technical change is less skilled-biased in Europe than in the US because Europe has developed labour market institutions that engender wage compression. This compression boosts investment in technologies that increase the productivity of less-skilled workers. The demand for the latter is therefore higher in Europe than in the US. On the other hand, if labour market institutions do not prevent the wage adjustment due to North-South trade and offshoring, the relative price of high skilled labour will increase followed by the cost of production of Northern innovating firms. This will lead to a slowdown in both R&D and productivity growth (Chusseau and Hellier, 2007).

5.4. Technology-induced offshoring

Several theoretical approaches consider that international outsourcing is linked to technology. In Glass & Saggi (2001), foreign outsourcing is driven by differences in technology between countries. By increasing profits, outsourcing provides a greater incentive for innovation. It depresses the wage of the North in relation to the South, but also produces a positive growth effect, which can offset the negative direct impact on the North. Kohler (2003) links up the mechanisms of different theoretical outsourcing models in a general equilibrium framework with both Ricardian and Heckscher-Ohlinian characteristics. International differences in factor prices and technology are the driving forces behind foreign outsourcing. The impact on factor rewards depends on the factor intensity of the production stages that remain in the country and not on the factor intensity of the stages that are outsourced.

Recent surveys still put forward SBTC as the main explanation of rising inequality, either directly or indirectly because it facilitates offshoring (Autor, Katz & Kearney, 2008; Gordon & Dew-Becker, 2008; Autor, 2010). These authors however point out the need to go beyond a simple distinction between low-skilled and high-skilled worker in explaining the labour market polarisation that has been witnessed recently in some countries.

5.5. Labour market polarization and trade-in-tasks models

Job polarization

A number of scholars have argued that equating skills to education is oversimplified and may blur substantial labour market inequality within education groups. According to Autor, Levy & Murnane (2003) information and communication technology (ICT) substitutes for workers that perform manual as well as cognitive tasks that can be accomplished by following explicit programmed rules, but complements for workers who perform problem-solving and complex communication tasks. Although this still implies that computers and other technical devices generally tend to bias demand in favour of highly educated workers, the distinction is not so straightforward. For instance, driving a car or filling a shelf are tasks that are not (as yet) sufficiently understood to be codified into software and to be performed by machines. As such they are non-routine tasks though they can be performed by workers without much formal education. Goos & Manning (2007) found evidence in favour of this view for the UK and De Grip & Dijksman (2008) for the Netherlands.

Trade-in-tasks models

Acemoglu & Autor (2011) proposed a general trade-in-tasks model to explain labour market polarization. They argue that the canonical model (the fact that skill-biased technical change dominated the increase in the relative supply of high-skilled workers) cannot explain (i) why certain groups of workers (e.g. US low-skilled male workers) suffered a decline in their real wages, and (ii) why labour markets appear to have polarized in terms of wages and jobs. In addition, it does not consider the possible substitution of computers for some occupations or tasks and the endogeneity of technological change. Skills, technology and international trade (offshoring) are considered as competing mechanisms to perform tasks. In line with Autor, Levy & Murnane (2003), technology (machines) is believed to displace routine and codifiable tasks which are considered to be performed -predominantly though not exclusively- by medium-skilled workers. Mechanisation, by replacing intermediate tasks will lead to medium-skilled workers performing some of the tasks previously performed by low-skilled workers. This thereby results in an increase in low-skill tasks, in line with the evidence, reported by e.g. Blinder (2006); Autor & Dorn (2011) and Goos & Manning (2007) on the increase in service jobs. Offshoring of routine information-based tasks to low-wage countries is considered as an alternative, competing mechanism. In addition, as it also primarily affects intermediate tasks, this will cause a decline in the number of tasks performed by medium-

skilled workers, and a decrease in relative wages, in relation to high-skilled as well as low-skilled workers.

Estimates of the trade-in-tasks models

For the US, Ebenstein et al. (2009) found a significant negative impact of offshoring on wages, the wage decrease being exacerbated when workers switched occupations: the wages of workers did not change as long as they stayed within the manufacturing sector but workers did witness a substantial drop in their wages when they switched towards the services sector. In support of Autor, Levy & Murnane (2003), workers performing routine tasks were affected the most by import penetration and offshoring. The latter finding was however not corroborated by Civril (2011) who used occupational data for the US. Using data on sales of US MNEs and industry-level data on task intensity, Oldenski (2011) found that US firms mainly offshored routine activities whereas non-routine activities remained at US headquarters. Goos, Manning & Salomons (2010) for EU countries and Michaels, Natraj & Van Reenen (2010) for a panel of nine EU countries, Japan and the US found evidence that technology produced labour market polarization. Whereas Becker, Ekholm & Muendler (2009) found support for the task-based view for Germany the analysis by Antonczyk, Fitzenberger & Leuschner (2009) indicated that a task-based view could not explain the rise in inequality at the top of the distribution and only explains part of the rising inequality at the bottom of the distribution in Germany.

6. Concluding remarks

In this chapter, we have reviewed the economic literature explaining the increase in wage inequalities between skilled and unskilled workers in advanced countries since the early eighties. Three main explanations have been put forward: (i) globalization characterised by the development of North-South trade, (ii) skill-biased technological change, and (iii) changes in institutions on the labour market and from a weakening of the Welfare State. Globalization and SBTC produce an increase in the relative demand for skilled workers.

A large amount of literature has estimated the impacts of technology, trade and institutions upon rising wage inequalities. The conclusions of the early empirical estimates state a significant influence from technological change, a non negligible impact of institutions in Anglo-Saxon countries, and a small impact of North-South trade. However, these estimates demonstrated several shortcomings, and from the mid 1990s, a series of new works have questioned the early results.

A new series of empirical and theoretical approaches have aimed at theorising the operating mechanisms of SBTC, North-South trade and labour market institutions, particularly modelling their interactions. The recent theoretical approaches have forged a better understanding of the operating mechanisms of SBTC, North-South trade and labour market institutions by modelling trade-induced technological change, labour supply-induced technological change, institutions-induced technological change and technology-induced offshoring. Two main results have been put forward by the new empirical estimates: (i) the impact of SBTC has been revisited, its supremacy questioned and (ii) offshoring is the main vector of impact from NST and may explain job polarization, as recently revealed in several OECD countries.

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